

### REMARKS

Claims 24-33 and 40-53 are pending in this application. Claims 1-23 and 34-39 have been canceled because of the final restriction requirement. Claims 24-33 stand rejected. Claims 40-53 have been added

### Election/Restriction

The Office has made the restriction requirement final and has accordingly withdrawn claims 1-23 and 34-39 from consideration in the present application. For the reasons of record, Applicant continues to disagree with the restriction requirement, but recognizes the finality thereof and has therefore canceled these claims.

### Objection to the Specification

The Office has objected to the disclosure in the specification because of the informalities noted on page 3 of the Office Action. Applicant thanks the Office for the detailed review of the specification and the noted informalities. As Applicant has amended paragraph [0048] of the specification, Applicant requests withdrawal of the objection to the specification.

### Objection to the Drawings

The Office has objected to the drawings as failing to comply with 37 C.F.R. § 1.84(p)(5) because they do not include the reference sign(s) for lead structure 22 mentioned in paragraph [0031]. Again, Applicant thanks the Office for the detailed review of the drawings and the noted informalities. With this Amendment, Applicant has submitted replacement sheets of all

IN THE DRAWINGS

Please replace the original drawings with the replacement sheets of drawings filed with this Amendment.

drawings that include references to lead structure 22. Accordingly, Applicant respectfully requests withdrawal of the objection to the drawings.

Claim Rejection: 35 U.S.C. § 102(e)

The Office has rejected claims 24, 27, and 33 under 35 U.S.C. § 102(e) as being anticipated by Hwee et al. (U.S. Patent No. 6,510,976) for the reasons noted on pages 4-5 of the Office Action. Applicants respectfully traverse this rejection.

The rejected claims currently contain the limitation of providing the lead frame with a solderable area surrounded by a solder dam and then attaching the die and the lead frame. The rejected claims also contain the limitation that a solder paste is provided in or on the solderable area and then the leadframe and the die are attached.

The Office has failed to show that Hwee et al. disclose these claim limitations. Hwee et al. disclose a process for forming the semiconductor package as outlined in Figures 3A-3E. Citing to column 6, lines 22-30, the Office argues that Hwee et al. provide a leadframe 100 with a solderable area surrounded by a solder dam 355 (depicted in Figure 3E).

Assuming, *arguendo*, that the Office's categorization of area 355 (which is part of the oxide layer 310 remaining after the die and leadframe are connected) as a solder dam is correct (an assumption Applicant traverses for the record), the Office has still failed to show that the skilled artisan would have recognized Hwee et al. as disclosing these two claim limitations. As noted above, the claims require that the leadframe is provided with the solderable area surrounded by a solder dam and then the die and the leadframe are attached. However, Figure 3E in Hwee et al. where 355 is shown, is formed after the die and the leadframe are attached: there

exists no element 355 in Figures 3A-3D. Accordingly, the skilled artisan would have understood that area 355 is formed after—not before—the die and the leadframe are attached.

The Office also argues that Hwee et al. provide a solder paste in or on the solderable area, citing to column 6, lines 17-20 where “during reflow ... the solder balls 330 changed to molten state.” Again, assuming *arguendo* that the Office is correct (an assumption Applicant traverses for the record), this argument still does not substantiate that the skill artisan and would have concluded that the solder paste is provided in or on the solderable area before the die and the leadframe are attached. Further, the skilled artisan would have understood that the solder paste (referred to as flux 335 by Hwee et al) is formed not on the leadframe, but on the solder balls 330.

Accordingly, the Office has not shown that Hwee et al. teach or suggest each recited limitation in the rejected claims. Accordingly, Applicant requests withdrawal of this ground of rejection.

Claim Rejection: 35 U.S.C. §§ 102 and 103

The Office has rejected claims 25-26 under 35 U.S.C. § 102(e) as being anticipated by, or in the alternative, under 35 U.S.C. § 103(a) as obvious over Hwee et al. for the reasons noted in pages 5-6 of the Office Action. Applicant respectfully traverses this ground of rejection.

To begin with, the Office has not substantiated that Hwee et al. teach the claim limitations described immediately above. And the Office has not even alleged or argued that these limitations would have been obvious to the skilled artisan in light of the disclosure of Hwee et al.

The Office recognizes that Hwee et al. do not disclose a metal stud that contains substantially no lead and, as well, do not disclose an amount of lead in the stud less than about 1 ppm. The Office maintains that it is reasonable to conclude that the copper stud of Hwee et al. would contain substantially no lead or the amount of lead in the copper stud would be less than about 1 ppm. Unfortunately, the Office has failed to provide any rationale or basis, whether express or implied, that would the skilled artisan to come to such a conclusion based purely on the disclosure of Hwee et al. But such rationale is required for a rejection of claims on the basis of anticipation.

Recognizing this, the Office contends that it would have been obvious to not have lead in the metal copper stud of Hwee et al. (presumably because of the knowledge available to the skilled artisan as evidenced by the disclosure of Oida et al. and Shimizu). Both of these references, however, do not lead the skilled artisan to the Office's contention of using less—or eliminating—lead in a metal stud. In the sections of these references relied on by the Office, both of them describe that lead or lead-related materials are eliminated from solder. Based on this knowledge, one with ordinary skill in the art would have understood that the solder balls 330—and not the copper studs 325—of Hwee et al. should not contain lead or contain only very small amounts of lead.

Accordingly, the Office has not shown that Hwee et al. teach or suggest every limitation in the rejected claims. Accordingly, Applicant respectfully requests withdrawal of this ground of rejection.

35 U.S.C. § 103: Hwee et al., Venkateshwaran et al., and Litani et al.

The Office has rejected claims 28-30 under 35 U.S.C. § 103(a) as being unpatentable over the Hwee et al. in view of Venkateshwaran et al. (U. S. Patent No. 6,316,822) and further in view of Litani et al. (U.S. Publication No. 2004/0169261) for the reasons noted on pages 6-7 of the Office action. Applicant respectfully traverses this rejection.

The Office recognizes that Hwee et al. do not disclose that the solderable area is supplied with a pad containing a non-oxidizable metal. Accordingly, the Office looks to the secondary references (Venkateshwaran et al. and Litani et al.) for such a teaching. Assuming, *arguendo*, that the three references are properly combined (an assumption Applicant traverses for the record), the Office has still failed to show the combination of these references teaches each and every limitation recited in the claims.

As noted above, Hwee et al. do not show several claim limitations whether alone or combined with Shimizu. And the Office has not relied on the secondary references to show that they teach or suggest these claim limitations that Hwee et al. do not disclose.

Further, combining the teachings of the secondary references with Hwee et al. as proposed by the Office would render Hwee et al. unsatisfactory for its intended purpose. Hwee et al. disclose using an oxide layer 310 and flux 335 in a process whereby the flux 335 cleans portions 340 of the oxide layer 310 off the interconnect locations 307 and the solder balls 330 when there is change to a molten state. Thus, portions 355 of the oxide layer 310 surrounding the interconnect locations remain and act as a passivation or solder mask. *See column 6, lines 17-25.* Consequently, the molten solder 345 can run up the copper posts 325 and improve the surface area of the copper post to which the solder 345 adheres. *See column 6, lines 26-29.*

To modify Hwee et al. as proposed by the Office and use a metal pad on the leadframe in the interconnect locations would not allow the flux and the oxide layer to interact as described in Hwee et al. to produce the desired results. Thus, the Office's proposed modification of Hwee et al. would render it unsatisfactory for its intended purpose, teaching away from making the combination proposed by the Office. *See M.P.E.P. 2143.*

Accordingly, the Office has not shown that the combined references teach or suggest every limitation in the rejected claims. Accordingly, Applicant respectfully requests withdrawal of this ground of rejection.

35 U.S.C. § 103: Hwee et al. and Siegel et al.

Claim 32 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Hwee et al. in view of Siegel et al. (U.S. Publication No. 2003/01434060) for the reasons noted on pages 7-8 of the Office Action. Applicant respectfully traverses this ground of rejection.

The Office notes that Hwee et al. do not disclose a film assisted molding process. The Office notes that Siegel et al., when discussing the background of the art, disclose a film assisted molding process. The Office concludes that it would have been obvious to modify Hwee et al. by using the film assisted molding process taught by Siegel et al. because a film assisted molding process helps cushion the clamping action of the transfer mold against the die surface.

Such a proposed combination of references, however, still does not show that Siegel et al. suggests those claim limitations which Hwee et al. fail to disclose, as described immediately above. Further, it is clear that the skilled artisan would not have been motivated to combine the references as proposed by the Office based on the disclosure of Siegel et al. In paragraph [008], Siegel et al. describe that the film assisted molding technique limits the type of material that may

be used because not all types of materials can be successfully used in the film assisted molding technique. Based on such a disclosure, the skilled artisan would have been motivated against using a film assisted molding technique since it limits the types of materials that can be used. *See M.P.E.P. § 2143.*

Thus, the Office has not shown where the proposed combination of references teaches or suggests each and every limitation of the rejected claims. Accordingly, Applicant respectfully request withdrawal of this ground of rejection.

35 U.S.C. § 103: Lo et al. and Melton

The Office has rejected claim 24 under 35 U.S.C. § 103(a) as being unpatentable over Lo et al. (U.S. Patent No. 6,507,120) in view of Melton (U.S. Patent No. 5,316,205) for the reasons noted on pages 8-9 of the Office Action. Applicant respectfully traverses this rejection.

The Office argues that Lo et al. describe the invention as claimed including a formation of a metal stud on a bond pad of a die. The Office notes that “stud” is interpreted as “a small knob, nail head, or rivet fixed in and slightly projecting from a surface” based on the description in the *American Heritage Dictionary*. Applicant respectfully disagrees that the skilled artisan would not have understood this claim term in light of the specification. Further, Applicant disputes that a common dictionary is the most appropriate place to turn for a definition of metal stud (assuming, *arguendo*, that a metal stud is not already defined in the specification). Applicant posits that there are numerous other sources of technical information that would be far more appropriate to show the definition of “stud” than a common dictionary.

The Office recognizes that Lo et al. fail to disclose providing a solder paste in or on the solderable area. Accordingly, the Office turns toward Melton for the disclosure of a solder paste



and concludes it would have been obvious to use the solder paste of Melton in the method of Lo et al. because a solder paste would help bond the gold bump to lead. Applicant respectfully disagrees.

In Figures 2-5 and the accompanying description, Lo et al. describe the formation of a semiconductor package. In that process, the active surface 212 of die 210 contains a plurality of bonding pads 216 on which bumps 218 are formed. The forming of bumps 218 also includes the formation of under bumped metal (UBM) layers. *See column 3, lines 9-13.* Lo et al. further describe that in this process, a solder paste of tin/lead could be applied on a surface of the under bump metal layer. *See column 3, lines 50-52.* In light of this disclosure, the skilled artisan would have understood that Lo et al. already used a solder paste.

Accordingly, the skilled artisan would have had no reason to turn toward Melton for a description of a solder paste. Rather, the skilled artisan would have just simply used the solder paste disclosed by Lo et al. But the solder paste of Lo et al. is provided not in or on the solder paste of the lead frame as recited in the claims, but on an UBM layer.

Thus, the Office has not substantiated that the proposed combination of references teaches or suggests each and every limitation in the rejected claims. Accordingly, Applicant respectfully requests withdrawal of this ground of rejection.

35 U.S.C. § 103: Lo et al., Melton, Venkateshwaran, and Litani

Claims 28-29 and 31 have been rejected by the Office under 35 U.S.C. § 103 as being unpatentable over Lo et al. in view of Melton, and further in view of Venkateshwaran et al. and Litani et al. for the reasons noted on pages 9-10 of the Office Action. Applicant respectfully traverses this rejection.

The Office recognizes that the combination of Lo et al. and Melton fail to teach a solderable area that is supplied with a pad containing a non-oxidizable metal. But the Office has not accounted for those claim limitations that are not taught or suggested by the combination of Lo et al. and Melton (as noted immediately above). The Office has not even alleged or argued that the secondary references (Venkateshwaran et al. and Litani et al.) teach or suggest such claim limitations.

The Office argues that the combination of the secondary references would suggest modifying the combination of Lo et al. and Melton to supply the solderable area with a pad containing non-oxidizable metal. Modifying Lo et al. in the proposed manner with the disclosure of the secondary references, however, would defeat the purpose of Lo et al. This reference describes in column 2, lines 20-24, that the leads should be directly superimposed on the bonding pads of the die without any die pad, with the result that (1) the area and the thickness of the package are reduced and (2) a shortened path for signal transmission and improved electric property of the package. Modifying Lo et al. however, by adding a pad would increase the thickness of the package and would increase the signal path and not result in the desired approved electrical property of package. Thus, the skilled artisan would not have combined the references as proposed by the Office because it would defeat one of the express purposes of Lo et al. *See M.P.E.P. § 2143.*

Thus, the Office has not substantiated that the proposed combination of references teaches or suggests every limitation of the rejected claims. Accordingly, Applicant respectfully requests withdrawal of this ground of rejection.

35 U.S.C. § 103 Pu and Lo et al.

The Office has rejected claims 24 and 33 under 35 U.S.C. § 103(a) as being unpatentable over Pu (U.S. Publication No. 2022/0182843) in view of Lo et al. for the reasons on pages 11-12 of the Office Action. Applicant respectfully traverses this ground of rejection.

The Office argues that Pu discloses providing a solder paste in or on the solderable area, citing to Figures 2-6 of Pu which depict the connection of chip 2 containing a bump 3 with lead frame 7 containing a bump 5 on the inner lead 71. The Office has not pointed to anything in the description accompanying Figures 2-6 of any type of solder paste that is used. The Office merely alleges that a solder paste is also bump 3, without any citation to any part of Pu. In fact, bump 3 is described by Pu as being an alloy of 63% tin/37% lead with a melting point of 183°C. *See paragraph [0040]*. In light of such a disclosure, it is unlikely that the Office could substantiate that the skilled artisan would understand this section to describe solder paste.

The Office recognizes that Pu failed to disclose that the solderable area is surrounded by a solder dam. The Office argues that Lo et al. describe such a feature and that it would be obvious for the skilled artisan to modify Pu with the disclosure of Lo et al. Interestingly, the Office notes that Pu appears to teach away from the use of a solder dam, but still maintains that it would be obvious to the skilled artisan to make such a modification to Pu. As noted by the Office, Pu strongly teaches away from using a solder mask or a solder dam in paragraph [0003]. And where the prior art teaches away from a modification, it is legally incorrect for the Office to ignore such a disclosure and contend that the skilled artisan would have modified the prior art anyway. *See M.P.E.P. § 2143*.

Thus, the Office has not shown that the proposed combination of references teaches or suggests every limitation of the rejected claims. Accordingly, Applicant requests withdrawal of this ground of rejection.

35 U.S.C. 103: Pu, Lo et al., & Shimizu

The Office has rejected claims 25-26 and 28 under 35 U.S.C. § 103 as being unpatentable over Pu and Lo et al., and further in view of Shimizu for the reasons noted on pages 12-13 of the Office Action. Applicants respectfully traverse this rejection.

As noted above, the combination of Pu and Lo et al. fail to teach or suggest every limitation of the claims. And the Office has not alleged or even argued that these claim limitations which are not disclosed by the combination of Pu and Lo et al. are taught or suggested by Shimizu.

The Office recognizes that the combination of Pu and Lo et al. fails to disclose that the metal stud contains substantially no lead, or that the amount of lead in the stud is less than about 1 ppm. Citing the first paragraph of column 4, the Office notes that Shimizu describes such a feature. As noted above, Shimizu et al. teaches in this section that the amount of lead in the solder material is below 1 ppm. But Shimizu is silent as to the amount of lead in the metal studs. Accordingly, since Shimizu is silent as to this feature, the skill artisan would not have been motivated to modify the combination of Pu and Lo et al. with the disclosure of Shimizu in the manner proposed by the Office.

Thus, the Office has not shown that the proposed combination teaches or suggests every limitation in the rejected claims. Accordingly, Applicant respectfully requests withdrawal of this ground of rejection.

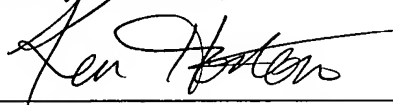
CONCLUSION

For the above reasons, as well as those of record, Applicant respectfully requests withdrawal of the existing grounds of rejection and allowance of the pending claims.

If there is any fee due in connection with the filing of this Amendment, including a fee for any extension of time not accounted for above, please charge the fee to our Deposit Account No. 50-0843.

Respectfully Submitted,

By



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